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Mortar FEs on overlapping subdomains for eddy current non destructive testing

The modelisation in eddy current (EC) non destructive testing (NDT) aims at reproducing the interaction between a sensor and a conductor in order to localize possible defects in the latter without damaging it. The finite element (FE) method is frequently used in this context as well suited to treat problems with complex geometries while keeping a simplicity in the implementation. However, in NDT, the modelisation has to be realized for different positions of the sensor, thus requiring a global remeshing of the problem domain. Different techniques to take into account the movement of a sensor avoiding remeshing have been studied (see *e.g.*, [1]-[4]). The mortar element method (MEM), a variational non-conforming domain decomposition approach [5, 6], offers attractive advantages in terms of flexibility and accuracy. In its original version for non-overlapping subdomains, the information is transferred through the skeleton of the decomposition by means of a suitable L^2-projection of the field trace from the master to the slave subdomains. At the occasion of Enumath 2001, a MEM with overlapping subdomains has been proposed to couple a global scalar potential defined everywhere in the considered domain and a local vector potential defined only in (possibly moving) conductors [7], and later applied to study electromagnetic brakes [8]. In this paper, a new FE-MEM able to deal with moving non-matching overlapping grids is introduced, which realizes the bidirectional transfer of information between the fixed subdomain (including the conductor and the air) and the moving one (represented by the sensor). The field source is in the moving part. This is indeed what occurs in EC-NDT, as the alternative current alimented inductive coils move over the conductors to detect possible defects on them (visible as a perturbation of the EC distribution). Two numerical examples are presented to support the theory. The first, an electrostatic problem with known solution, to state the optimality of the method. The second, an EC-NDT application, to underline the flexibility and efficiency of the proposed approach. This work has the financial support of CEA-LIST.

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